

REMARKS

Claims 1 - 3, 5 - 7, 9 and 10 remain active in this application. Claim 1 has been amended. Support for the amendments of the claims is found throughout the application, particularly in Figure 2 and the description on pages 9 and 12. No new matter has been introduced into the application.

claims 1 - 3, 5 - 7, 9 and 10 have been rejected under 35 U.S.C. §112, first paragraph, as failing to comply with the written description requirement thereof. This ground of rejection is respectfully traversed, particularly as being moot in view of the amendments made above.

It is respectfully submitted that this ground of rejection is substantively in error. It is respectfully pointed out that the clearly disclosed principal object of the invention, also recited in claim 1 by reference to a barrier to process materials, is to avoid uncontrolled reactions with copper and the preferred materials are clearly suitable for that purpose and have a suitably low reactivity with copper. Use of other materials is also clearly disclosed on page 9, lines 11 - 24. Therefore, logically, it is respectfully submitted that recitation of a "reactivity with copper which is equal to or less than" the preferred materials is, in fact, fully supported by the original disclosure even if not recited verbatim. However, by the above amendment, the language erroneously asserted to be insufficiently supported has been deleted and language explicitly appearing at page 9, lines 11 - 24, which is of much the same import, has been substituted to comprehend equivalents of the materials recited in claims 2 and 3 for the purposes which are also explicitly recited in claim 1. Accordingly, it is respectfully submitted that this ground of rejection is not only in error but now

clearly inapplicable to claim 1 and the claims depending therefrom and reconsideration and withdrawal of the same is respectfully requested.

Claims 3 and 7 have been rejected under 35 U.S.C. §112, second paragraph, as being indefinite. This rejection is also respectfully traversed, particularly as being moot in view of the amendments made above.

It is respectfully submitted that the description of two layers of a "multi-layer" structure in a claim does not preclude the recitation of a description of additional layers in a claim depending therefrom. However, to resolve the issue, the Examiner's suggestion of adding the phrase "at least" has been adopted and the issue is now clearly moot. Accordingly, reconsideration and withdrawal of this ground of rejection is respectfully requested.

Claims 1 - 3 and 5 - 7 have been rejected under 35 U.S.C. §103 as being unpatentable over Colgan et al. in view of Shue et al. and Uzoh and claims 9 and 10 have been rejected under 35 U.S.C. §103 as being unpatentable over the same combination of reference in view of Jain. These grounds of rejection are respectfully traversed.

Colgan et al. and Shue et al. were previously applied to claims 1 and 5. It was previously pointed out in the response filed April 30, 2004, hereby fully incorporated by reference, that "Colgan et al. is relevant to the present invention only as disclosing the environment of the invention: an integrated circuit having an aluminum wiring level above a copper wiring level. Colgan et al. does not recognize the problem of corrosion of copper by process materials when forming a tungsten stud for connection between copper and aluminum wiring layers, much less proposing a solution by formation of a barrier liner in a via prior to tungsten deposition. Rather, Colgan et al. addresses the problem of metal migration when copper and aluminum

are in contact with each other (and not separated by a tungsten stud) and does so by providing "a continuous path for copper and aluminum atoms to move in the interconnect structure" (Abstract, last sentence). Therefore, interposition of any type of barrier in or by use of an interconnect material of another material would prevent operation of Colgan et al. in the intended manner and, hence, any modification of Colgan et al. which would include provision of such a barrier (including the barrier 28a or stud layer 30a of Shue et al.) would be improper under *In re Gordon*, 221 USPQ 1125 (Fed. Circ., 1984), as noted in the previous response." An argument was also presented in regard to Shue et al. These arguments have been explicitly indicated to have rendered the previous rejection moot and to have required the inclusion of Uzoh in both of the grounds of rejection based on prior art in the present office action.

In response to these present grounds of rejection, it is respectfully pointed out that Uzoh does not contain the teachings or suggestions attributed to it by the Examiner and, like Colgan et al., cannot properly be modified to answer the recitations of the claims. Specifically, while Uzoh may teach claimed materials, it does not teach or suggest a barrier layer as a via liner which will resist attack of copper by process materials during formation of a via between a copper layer and an aluminum layer. Rather, like Colgan et al., Uzoh is concerned with developing a "single crystalline conductor material extending through the structure" and does so by "utilizing an open-bottomed via liner structure, as noted in the Abstract, column 2, line 43, and elsewhere in Uzoh. Note also in Figure 2(b) of Uzoh, layer 32 is, itself, preferably copper and has no protection applied thereto but, rather, merges with the metal of the stud 34, evidently during deposition of the stud 34 or

subsequent annealing discussed at column 6, lines 12 - 30, as shown in Figure 2(c). Therefore, any modification addition of any barrier layer such as an uninterrupted layer or closure of the bottom of the trench would preclude operation of Uzoh in the manner intended under *In re Gordon*, 221 USPQ 1125 (Fed. Circ., 1984) as previously argued in regard to Colgan et al. Perhaps more simply put, the provision of a barrier of any kind, especially of the type claimed would preclude the motivation for the combination which the Examiner explicitly asserts in regard to Colgan et al. and Uzoh. Thus neither Colgan et al. nor Uzoh can be properly modified to answer the recitations of claim 1.

Moreover, for the reasons pointed out in the previous response, Shue et al., even if (*arguendo*) properly combinable with Colgan et al or Uzoh, does not address the problems of attack of copper by process materials, small via size or reducing the number of required aluminum layers or provide the solution claimed, particularly since tungsten is disclosed as a suitable barrier material and thus Shue et al. does not and cannot provide evidence of a level of ordinary skill in the art that would support the conclusion of obviousness that the Examiner has asserted. It is also respectfully pointed out that the Examiner's paraphrase (b) of recitations of claim 1 in regard to an admitted deficiency of Colgan et al. for which Shue et al. is applied is substantively incorrect and indicated either a lack of understanding of the invention and/or Shue et al. or the utilization of impermissible hindsight or both. Likewise, Jain, applied against claims 9 and 10 only for teaching a covering layer, is not properly combinable with Colgan et al., Uzoh et al. and/or Shue et al. and, even if (*arguendo*) properly combinable, does not teach a multi-layer via liner and does not address any of the problems to which the present invention provides a solution and does not supplement

the teachings of Colgan et al. Shue et al. or Uzoh at any of the points of deficiency to answer the claims pointed out above.

Accordingly, it is clearly seen that the present grounds of rejection are substantively in error and the teachings of the applied references are improperly combined and even if properly combinable, do not answer the explicit recitations of the claims. By the same token the Examiner has not made a *prima facie* demonstration of obviousness of any claim in the application but, rather, the deficiencies of the prior art and the impropriety of their combination is clearly indicative of the utilization of impermissible hindsight in the rationale for the rejections stated by the Examiner. Moreover, the burden of the Examiner to make a *prima facie* demonstration of obviousness is not lessened in this regard by assertion that certain claim language justifies consideration of the claims as product-by-process claims, particularly since the language asserted to do so has been replaced by language which clearly does not do so. Even if (*arguendo*) claim 1 could be properly considered to be a product-by-process claim, the Examiner has not demonstrated obviousness of inclusion of a multi-layer barrier that resists attack by process materials, as claimed. Accordingly, it is respectfully submitted that these grounds of rejection based on prior art are clearly seen to be in error and reconsideration and withdrawal of the same are respectfully requested.

Since all rejections, objections and requirements contained in the outstanding official action have been fully answered and shown to be in error and/or inapplicable to the present claims, it is respectfully submitted that reconsideration is now in order under the provisions of 37 C.F.R. §1.111(b) and such reconsideration is respectfully requested. Upon reconsideration, it is also respectfully submitted that

this application is in condition for allowance and such action is therefore respectfully requested.

If an extension of time is required for this response to be considered as being timely filed, a conditional petition is hereby made for such extension of time. Please charge any deficiencies in fees and credit any overpayment of fees to Deposit Account No. 09-0458 of International Business Machines Corporation (E. Fishkill).

Respectfully submitted,



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